THE CLINICAL VALUE OF THE AVERAGE ANALYSIS OF GASTRIC CONTENTS.*

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I HAVE been led to a consideration of this subject by reading a passage in Hemmeter's[1] book on *Diseases of the Stomach,* in which he says: "It would be a valuable contribution by various gastro-enterologists of the United States if they collected and reported the frequency of hyperacidity and other gastric diseases occurring in their localities, so as to throw light on the influence of race, climate, and geographical distribution," etc., and further, by reading a statement by Riegel,[2] that the determination of the frequency of hyperchlorhydria will remain impossible, so long as every dyspeptic is not examined by lavage, and that hyperchlorhydria is encountered more frequently in private practice than in hospitals, because the symptoms of this condition are generally not severe enough to send the patient to an institution. It is evident that there is much truth in both of these apparently opposite statements, but of the two, the one which appeals to us most in connection with the subject in hand is that of Riegel, for it demands a thorough examination of each case in as scientific and uniform a manner as possible. So long as the various observers in different parts of the country do not employ the same methods and base their conclusions upon uniformly imposed conditions, so long will it be impossible to correctly determine the actual prevailing distribution and frequency of chronic gastric diseases.

We have but to glance at the reports of various observers in different parts of the world to see the force of these statements. If we take hyperchlorhydria as an example, it will be found that, so far as its frequency is concerned, it is reported as follows: by Schneider[3] (Zurich) at 5 per cent., by Kovesi[4] (Budapest) at 30 per cent., by Johnson and Böhm[5] (Stockholm) at 36 per cent., by Jaworski[6] (Lemberg) at 50 per cent., of all chronic gastric diseases; by Mathien, Bouveret, and Renaud, as exceedingly frequent in France; by various American authorities at about 50 per cent. of all stomach cases; and by Fleiner[7] (Heidelberg) and Westphalen[8] (St. Petersburg) as comparatively rare.

There can be no doubt that the different results which come to us from Continental observers may be due, in part, to differences in nationality, temperament, class conditions, and especially food, but it is also probable that they are due to non-uniform methods of examination, and a divergence of the imposed conditions for judging this complaint. This latter fact is especially pertinent to this country, for differences of nationality and temperament are, to a certain extent, blended here by social conditions, customs, and intermarriage; but, what is more important still, is the fact that economic conditions are such that differences in diet due to class distinctions do not operate to the same extent as they do on the Continent. We have no potato-eating Irish peasantry or rice-eating Japanese peasantry as national factors. The general scale of wages makes it possible for most artisans and laborers to nourish themselves in a proper manner. This is more than evident with ordinary skilled labor at five dollars per day. If, then, there are differences of opinion as to the relative frequency of chronic gastric diseases, we must look for the cause of these in a non-uniformity of methods employed and a diversity of opinions as to the necessary conditions to be imposed upon a patient in order that a correct diagnosis may result.

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In this connection, I have chosen the acid secretion of the stomach as the subject for inspection, simply because it is the function about which we know the most and the knowledge of which, after all, so far as the diagnosis of most chronic diseases is concerned, gives us the greatest aid. It is also in the determination of hydrochloric acid that the greatest errors in judgment are made. These errors do not relate to the actual chemical reactions which take place in the test-tube or beaker after the gastric contents have been extracted, but relate to the best possible methods for developing the acid secretion of the stomach for clinical purposes. The simple finding of such and such a quantity of hydrochloric acid at a given time in a given stomach often serves only to mislead. The real object of gastric analysis is to determine the secreting capability of the stomach under the conditions in which it finds itself. This leads to a consideration of the methods which are employed for this purpose.

The whole question resolves itself into this: Can we secure a better knowledge of the gastric-acid secretion by employing carbohydrates or proteids, as exemplified in the ordinary test breakfast of Ewald or the more complicated meat-containing meal of Riegel? Or had we better use both of these meals; or, would it be wiser to discard both of these tests as placing the organ under unnatural conditions, and examine the same under the circumstances in which it finds itself, and containing the food to which the individual has been accustomed, or which has led to his discomfiture?

It would appear at first sight to be rank heresy to make a proposition such as the last, after the years of trial which the first two methods have endured; but it is also evident that there is a certain difference between gastric analysis for scientific purposes and gastric analysis for clinical diagnosis. The proposition is further justified, when we consider that very few people take kindly to tea without milk or sugar and dry bread, and that in a certain proportion of cases a diagnosis, which remains uncertain under the usual tests, suddenly becomes clear as day if the patient is placed on his natural diet and usual conditions of life.

In order to fully consider the question, it will be necessary to review in brief three separate lines of experiment which have been pursued for years, and which have a direct bearing upon it. They may be called the diagnostic, the dietetic, and the physiological. The first two are closely allied in that they have had for their object the study of the extreme development of the acid secretion of the stomach, and the results which have been obtained in each are directly interchangeable, for that food product which is of greatest service in the development of the acid secretion for diagnostic purposes would necessarily play an important part in the treatment of gastric conditions in which the quantity of acid is found to be abnormal. A study of the question would further be incomplete should we not take into consideration the remarkable results obtained by Pawlaw in the purely physiological line, for these have revealed the marked influence of such special senses as taste, sight, and smell upon the gastric secretions in general—factors of the greatest importance in this connection.

The value for diagnostic purposes of the ordinary trial breakfast of Ewald or the proteid-containing meal of Riegel has been variously estimated by different observers. Ewald, Boas, Leube, and Jurgensen have been the chief defenders of the first, whereas Riegel, Fleiner, Fleischer, and Rosenheim have contended for the latter. The objections to the test breakfast are its simple, non-stimulating character, that it does not appeal to the special senses, and hence does not give an adequate knowledge of the secreting capability of the stomach. On the other hand, its uniform character seems to be the quality which appeals most to those who prefer it. The chief objections to the meat-containing meal have been its non-uniformity of character and the greater difficulty in manipulating it. In this connection, Rosenheim,[9] while admitting the general utility of the test breakfast, says that the meat-containing meal is better suited to scientific purposes. Fleischer[10] contends that the trial breakfast is non-stimulating, and Fleiner[11] regards the use of the two meals as largely dependent upon the habits of the patient. Riegel[12] admits the uniformity of the test breakfast, but says that it gives an insufficient idea of the secreting capability of the stomach, for a stomach may be able to produce free hydrochloric acid with a test breakfast and yet be incapable of doing the same when called upon to digest a general diet containing proteids. Leaving aside considerations of non-uniformity of character or ease of manipulation, the whole subject seems to resolve itself into a discussion of the stimulating properties of carbohydrates and proteids to the gastric secretions, for an ordinary test breakfast, after all, is largely carbohydrates. (The ordinary wheat of the United States, according to König, contains about 10 per cent. water, 10 per cent. nitrogenous product, 2 per cent. inorganic substances, and the remainder carbohydrates.)

Another phase of the same controversy which has been going on for years relates to the proper dietetic treatment of such abnormal gastric acid conditions as hyperchlorhydria. This was practically begun by von Sohlern,[13] in 1891, after Moritz[14] (1889) and von Jaksch[15] (1890) had declared, from clinical observation, that carbohydrates were less stimulating to the gastric secretions than proteids. Briefly glancing over the various turns in the struggle, we find that von Sohlern placed all his patients upon a carbohydrate diet and was followed in the course of years by Rosenheim, Fleiner, Justesan, and Jurgensen. In 1895 Schüle,[16] after more exact experiments upon normal stomachs, declared the free hydrochloric acid was about the same in both diets, that there was a slight increase of the total acidity in cases where proteids were administered, and that the height of digestion was prolonged in the latter class of cases. In 1897 Jurgensen[17] opposed the view of Schüle by declaring that a proteid diet directly increased the quantity of acid secreted, on account of its greater combining power. In 1898 Sorensen and Mezgar,[18] experimenting upon cases of hyperchlorhydria, expressed the opinion that in this condition the free hydrochloric was about the same in both diets. In the same year Hemmeter[19] advised the use of carbohydrates in hyperchlorhydria, on account of the danger of a greater proliferation of the oxyntic cells than already existed in this condition. In 1899 Schüle[20] admitted that carbohydrates caused less secretion in hyperchlorhydria, but still maintained that the free hydrochloric acid was practically the same in both diets, and that in normal cases there was no great difference between the two.

This variety in the results obtained can only be explained by the diversity of the methods employed and the conditions imposed. In some cases normal stomachs were utilized and in others hyperchlorhydric ones. Some experimenters employed as tests meat and water, others potatoes and water, and still others bread and beef-tea. In 1899 Bachmann,[21] realizing the vagaries of former experiments, attempted to eliminate them by administering his various foodstuffs according to their nutritive values as expressed in heat units liberated by their combustion and considered only the absorbable portion of the products in his calculations. In short, he determined the quantity of food to be administered according to the isodynamic values of Rubner. These indicate that 100 grams of bread equal 190 grams of beef, or 180 grams of eggs, or 300 grams of potatoes, or 335 grams of oatmeal, or 390 grams of milk. The water contained in each was taken into consideration and proper mixtures made, so that the isodynamic value of each combination was the same.

The experiments were conducted upon previously cleansed normal stomachs, and repeated until the results were constant. The results obtained relate to the free hydrochloric acid, the total hydrochloric acid, the total acidity, the time of maximum secretion, and the duration of digestion. It was found that the first exhibition of free hydrochloric acid takes place for bread in one-half to three-quarters of an hour, for beef in one to one and one-half hours, for potatoes and milk in three-quarters to one hour. Free hydrochloric acid appears one-half an hour earlier in a bread test meal than in an isodynamic one containing beef. Free hydrochloric acid was greatest in case of potatoes and lowest in case of milk and eggs. With a standard for bread taken at 100 the quantity of free hydrochloric acid secreted for beef and potatoes would be 11 per cent. to 21 per cent. plus respectively, and for eggs and milk 14 per cent. to 16 per cent. minus respectively. Such differences existed for simple foods. In cases of more complex diets, that one containing beef showed on the average 12 per cent. more free hydrochloric acid. According to the same standard, the total hydrochloric acid was found to be 5.3 per cent. plus for potatoes, 36.2 per cent. plus for beef, 14.2 per cent. plus for eggs, and 1.3 per cent. plus for milk. In a complex meal containing beef the total hydrochloric acid was 22.5 per cent. plus. The total acidity was 35.5 per cent. higher in a beef-containing meal. The results obtained for the duration of digestion of the various foods was about the same as that given by Penzoldt. From all of which Bachmann concludes that a vegetable diet is indicated in hyperchlorhydria, suggesting that there are two objects of treatment in this condition, namely, the symptoms themselves and the process producing them (*indicatio symptomatica* and *indicatio morbi*). All treatment should be directed to the latter, advice which had already been given by Jurgensen and Hemmeter.

From such experiments, carried on in normal stomachs under exact scientific conditions, it was reasonable to suppose that the question had been more or less definitely settled. Here, however, we again encounter the difficulties which separate the results obtained by scientific experiment and the direct application of the same for clinical purposes. In 1900 Mayer,[22] operating in Boas' laboratory, while admitting the scientific soundness of Bachmann's observations, arrived at the conclusion that before the same could be of practical value, it would be necessary to demonstrate that the prolonged use of a vegetable diet could produce a diminution of the quantity of acid secreted. Experimenting with distinct vegetable and meat diets successively upon the same cases of hyperchlorhydria over extended periods of time, he found that the free hydrochloric acid and the total acidity were increased by the continuous use of vegetables. This peculiarity Mayer ascribes to the necessary increased bulk of a vegetable diet and the consequent increased mechanical irritation of the mucous membrane. On the other hand, the continuous use of proteids in this condition can only be looked upon as a palliative measure, in so far as such a diet has a greater combining power.

Nothing can demonstrate the soundness of these views better than the experience of actual practice. Aside from the utter impossibility of feeding patients for any length of time upon distinct carbohydrate or proteid foods, the results obtained thereby do not justify the means, for, notwithstanding the possibility of increasing or diminishing the demands made upon the average stomach by regulating the diet in one direction or the other, it will usually be found that in the great majority of cases the tendency to secrete too much or too little acid will persist even though all actual symptoms of the disease have disappeared. I have repeatedly examined at long intervals the gastric contents of patients who had suffered for years either from increased or diminished acidity and who had apparently recovered the entire use of the organ, judging from their general comfort and good physical condition, only to find that the same abnormalities of secretion continued to exist. This is most forcibly illustrated in a half-dozen cases of gastroenterotomy in which it was possible to make yearly complete physical and chemical examinations, and which exhibited no changes in their secretory conditions at the end of four, five, and six years, notwithstanding the fact that the causes for the original abnormal secretion of acid had been removed by operation. The importance of this tendency is being realized more and more yearly, and the growing feeling, judging from the most recent literature, is to place patients afflicted with abnormal gastric acid secretions upon plain, bland, and nutritious diets, with less consideration shown for their actual chemical composition than for their unirritating physical properties.

It may appear at first sight to have been superfluous to enter into this review of treatment in a discussion which only involves diagnosis, but as our methods for the development of the acid secretion of the stomach are mainly dietetic, it has seemed necessary to do this in order to have a comprehensive view of the whole subject, for it sometimes happens that the differential diagnosis of obscure gastric affections must depend upon differential treatment. The differentiation between gastric ulcer with hyperchlorhydria and simple gastralgia with hyperchlorhydria can often only be made in this way. If further there exists doubt as to the proper dietetic treatment of abnormal acid conditions in the stomach, there must also exist doubt as to the best method for diagnosing them.

In every case of chronic gastric disease involving abnormal acid secretion, the object of examination is to develop, if possible, the average capability of the stomach to secrete acid and to discover any vagaries of the same which may exist. In order to do this intelligently it would appear to be necessary to place the stomach under its most natural conditions. Can we do this by giving simple tea and dry bread? A partial solution of this problem is found in the results obtained by Pawlaw[23] by physiological experiments conducted to show the influence of real and fictitious feeding. Briefly tabulated for the purpose of reference, these would be the following: 1. The centres for gastric secretion are located in the stomach wall (splanchnic section causes no cessation of secretion). 2. The vagi serve as transmitters of mental impressions, such as appetite and control secretion in an inhibitory manner (section of the nerves causes hypersecretion during the first few weeks after operation). 3. The quantity of gastric secretion stands in direct relation to the quantity of food introduced. 4. The secretion of acid is continuous during digestion, begins four to five minutes after the introduction of food, and gradually rises and falls to and from the height of digestion. 5. Each particular food has its special acid curve, the summit of which is reached most rapidly in a meat diet. 6. Simple mechanical irritation of the gastric mucosa produces no acid secretion.

The principal impression conveyed by these results, so far as diagnosis is concerned, is that any food test for the development of the gastric acid secretion which is to give satisfactory data for judging the average functional capability of the stomach must not only appeal to appetite, inducing special senses of sight, taste, and smell, but must also be a direct stimulant to the secretory centres in the stomach wall, for Pawlaw has demonstrated that the acid secreted during the first half-hour of digestion is due to the first, and that the real contact stimulation begins later. In the words of Troller, the test must be a physiological stimulant and a physical-chemical stimulant. An interesting experiment is recorded by Pawlaw in this connection. By feeding a dog 200 grams of food he secured 135 c.c. of gastric juice. By directly introducing the same quantity of food into the stomach through a fistula he secured 50 c.c. of gastric juice (sympathetic stimulation). By fictitious feeding of the food he secured 75 c.c. of gastric juice (vagus stimulation). The sum of the last two quantities would be 125 c.c., or pretty nearly the quantity obtained by feeding the animal in the natural way. Pawlaw found further that the introduction of simple substances, such as dry bread, starch, peptone, or egg albumen into the stomach, produced very little secretion. If, however, they were masticated first they caused some secretion. Troller also found that the introduction of food into the stomach through a stomach tube in the human subject produced much less acid secretion than if the same were first masticated. On the other hand, the mastication of tasteless substances caused very little acid secretion.

If we accept these results obtained by clinicians and physiologists —and there is no reason up to the present why we should not—the ordinary trial breakfast does not fulfil the requirements of a physiological test for the acid secretion. It fails in three ways: It fails to excite the appetite, and hence the vagus stimulation in those cases in which it is taken with repugnance. It fails to be a physical-chemical stimulant because it does not act as an energetic stimulant to the secretory centres. It fails because it places the individual in an unnatural condition of life for examination. Hence it cannot be surprising that this meal should give a variety of results in clinical work, results which in a good proportion of cases are erroneous, or, stated in a more conservative manner, results which may be correct for tea and bread, but erroneous for the average normal diet of the individual.

In order to demonstrate this, I have taken statistics from some hundreds of cases of my records by comparing the results obtained from successive analyses in the same cases. Among women, three-quarters to one hour after a trial breakfast, I found 60 per cent. were hypochlorhydric, 30 per cent. normal, and the remainder hyperchlorhydric. Upon the next examination I found that 57 per cent. had remained stationary, whereas 43 per cent. had changed as follows: of the subacid cases, 22 per cent. became normal and 2 per cent. hyperacid; of the normal cases, 14 per cent. became subacid; and of the hyperchlorhydric cases, 2 per cent. became normal. Among men the changes were not so marked. Of these cases, 43 per cent. were subacid, 35 per cent. were normal, and 22 per cent. hyperchlorhydric. Upon the next examination 72 per cent. remained stationary and 28 per cent. changed as follows: of the subacid cases, 10 per cent. changed to normal; of the normal cases, 4 per cent. changed to subacidity and 6 per cent. to hyperchlorhydria; of the hyperchlorhydric cases, 12 per cent. changed to normal and sometimes to subacidity. Taken collectively, men and women, it was found that 60 per cent. remained stationary and 40 per cent. had changed upon successive examinations.

This variation cannot be due to the uncertainty usually attached to first examinations. These were carefully excluded, as I have come to the conclusion that first examinations generally give false results. This is due to misunderstanding in regard to quantity and quality of the food to be taken, duration of digestion, and such emotional disturbances as anxiety, uncertainty, and fear. Upon the second examination these objections are largely removed. Nor can the variation be attributed to nervous dyspepsia, for such cases were excluded from the list. There remains but the one conclusion that the differences in results are due to something inherent in the test itself. This is not surprising when we recall the results obtained by Pawlaw. The average patient approaches plain tea and dry bread with disgust and annoyance. It does not appeal to his appetite through the special senses, and yet nearly one-half of the gastric secretion is induced through them. In this connection, we have the interesting observation, made by Pawlaw, Bachmann, and Buch, that the addition of a little butter to the bread, thus rendering it more palatable, will often materially increase the quantity of acid secreted, though fats are supposed to inhibit the acid secretion. That this appeal to the appetite of the individual is of paramount importance is best illustrated in the one-time manufacture of commercial pepsin, when pigs were placed within sight and smell, but out of reach, of enticing food, only to be slaughtered after a length of time sufficient to allow the peptic glands to become filled had elapsed.

It will be asked why the ordinary test breakfast, which is so slightly stimulating, should produce hyperchlorhydria in any case. The anomaly can be explained in various ways. In some of these cases the increased acidity is only momentary, and is due to emotional disturbances, for such may induce either hypochlorhydria or hyperchlorhydria in stomachs which, as a rule, are perfectly normal. In other cases the abnormality is due to defective innervation of the stomach itself, in so far as the gastric secretion does not adapt itself to demands made upon the organ. In other cases, still, the hyperchlorhydria may be due to proliferation of the oxyntic cells, so that the introduction of any food substance into the stomach would probably cause an increased acidity. In the first two classes of cases the administration of a more palatable diet will cause the hyperchlorhydria to disappear. In the last class such administration will cause a still higher acidity, in that the secretion of acid is directly proportional to demand as in normal stomachs, the only difference being that in hyperchlorhydric cases there is an increase of gastric secreting cells. It is not always possible to demonstrate this by estimating the free hydrochloric acid alone, as the total hydrochloric acid may be increased markedly without there being any evidence of this in the quantity of free hydrochloric acid present. This latter quantity may fluctuate to a certain extent in the case of more complex diets. This is due not only to the combining power of the administered food, but also to the muscular activity of the gastric walls to secure a thorough admixture of the food and the acid secreted; and, further, to the intensity of the chemical reactions which takes place in the stomach, for from recent experiment there is some evidence that the combination of hydrochloric acid and proteid within the stomach need not be permanent, but that part of the acid may be released from the acid-proteid molecule to begin anew the attack upon other proteid molecules.

It is not necessary to conclude from these observations that the ordinary test breakfast has lost its usefulness. On the contrary, as a preliminary and comparative test, it is invaluable, for any stomach which will secrete too much acid with this test may be said to have something wrong either in its innervation or its secreting structures. In order to determine the causes of abnormal secretions produced by this method, it would be advisable to compare the results obtained by it with those obtained by other methods from which some of its objectionable features have been removed; in other words, some test which will appeal more to the patient and which will be more normally physiological in its action.

Some of the objections to the test breakfast can be removed by the addition of proteids of some kind, as typified in the meal of Riegel. Such addition would serve several purposes. It would render the test more acceptable to the patient in that its preparation would enhance its savor. The results obtained would roughly indicate the difference between carbohydrate and proteid stimulation. In cases of subacidity after a simple test meal the increased stimulating quality of the proteid may produce a normal quantity of acid, showing that the membrane is still in condition to furnish sufficient acid for digestive purposes. Finally, in some cases of hyperchlorhydria after a test breakfast, due to the exotic nature of the latter, proteids may again produce normal results. In many cases deceiving extremes would be curtailed, and we should expect more uniform results. In order to accomplish these ends in the simplest possible manner, it has been my custom to employ a meal composed of the ordinary test breakfast, with the addition of one-quarter of a pound of lean, finely chopped beef prepared by broiling and slight seasoning to render it palatable. This meal is usually taken with relish, is easily extracted from the stomach, and filters as readily as an ordinary test meal. It is examined three hours after it is taken.

Operating in this manner upon a long series of cases, 40 per cent. were found to be subacid, 46 per cent. normal, and 14 per cent. hyperchlorhydric. Upon further examinations, 35 per cent. remained subacid, 54 per cent. remained normal, and 11 per cent. hyperchlorhydric. Compared with the results obtained after trial breakfasts, the number of subacidities was reduced 23 per cent., the normal cases increased 15 per cent., and the hyperacid cases increased 9 per cent. This would indicate that the results after the proteid-containing meal are not only more constant, but also that the frequency of the various conditions is changed, the general tendency being to bring the extremes of secretion to the normal standard. This is perhaps best illustrated in a series of cases in which both meals were employed. In these cases after several examinations the free hydrochloric acid remained stationary in 67 per cent. In 33 per cent. the free hydrochloric acid after trial breakfasts was diminished in 18 per cent. and increased 15 per cent. after proteid meals. Of the subacidities after the trial breakfast, 70 per cent. remained stationary and 30 per cent. advanced to normal after the proteid meal. In the same manner 27 per cent. of the normal cases became subacid and 64 per cent. remained stationary, judging from the free hydrochloric acid alone; 38 per cent. of the hyperchlorhydric cases became normal after proteids. In 20 per cent. of the cases anachlorhydria prevailed throughout.

Whatever these results may be worth, they at least illustrate that a palatable proteid-containing test will often prevent errors in the judgment of the secreting power of the stomach by appealing to both sources of gastric secretion and by placing the stomach under more natural conditions. It has been my experience to find that, while on the one hand the repair of the secretory functions of the stomach when once damaged is exceedingly slow and generally impossible; so, on the other hand, the impairment of the same functions is slow also, and that many stomachs which under the ordinary clinical tests do not secrete properly, will do so provided they are given an opportunity. In tempting a stomach to secrete with simple tea and bread, we are only replacing the starvation diet, to which most chronic dyspeptics have long subjected themselves by a starvation test, and it is known to everyone what a liberal change in this direction will often do for a great many of these patients.

Aside from these advantages derived from the systematic and successive administration of these two tests for judging the capability of the stomach to secrete, there is another which should not be neglected. This relates to the possibility to suspect the pathological processes which have taken place in the secretory structures by an analytical comparison of the various results obtained by the two methods. If a stomach which is persistently subacid after trial breakfasts becomes normal after proteids, we may safely conclude that the secretory structures are normal. Without the proteid test the subacid condition may just as well have been attributed to a neurosis (provided always that there were not other signs of structural changes), for there had been no sufficient demand made upon the organ by the simple tea and bread. With such results one would also be justified in suspecting an atonic condition, in that the continuous presence of food had rendered the organ less sensitive to slight stimulation. If, on the other hand, the subacid condition remains stationary after both tests, it is quite probable that organic changes have occurred, for the increased stimulation of the proteid should have produced more acid, even in cases where a neurotic element exists. In those cases in which a subacidity after trial breakfasts suddenly develops into a hyperchlorhydria after proteids, there is fair evidence that a condition of defective innervation may be present, for were the cause of the marked difference to be found in a proliferation of the gastric cells in the sense of Hemmeter, Einhorn, and Cohnheim, we should, at least, have had normal acidity, with such slight stimulation as tea and bread affords. The same condition of defective innervation may be suspected in those cases of hyperchlorhydria after a trial breakfast which become normal after proteid meals, for there is nothing in the stimulating property of a trial breakfast to call for the increased acid secretion. If, however, a hyperchlorhydria after a trial breakfast persists or increases after proteids, we have good reason to judge the case one where proliferative changes have taken place in the mucous membrane, for the secretion of acid has been directly proportional to stimulating properties of the food. This is especially the case if the symptoms of hyperchlorhydria occurs several hours after meals, showing that the secretion of the acid has been progressive and not regular. If, on the other hand, the symptoms and the production of increased acidity occur directly after meals and gradually disappear as digestion progresses, we may again suspect defective innervation. In these cases the secretion of acid is irregular, in that the mere presence of food is sufficient to cause a very rapid secretion of acid not regulated by demand and which soon exhausts itself through its own energy. Hence, both symptoms and hyperchlorhydria disappear during the later stages of digestion. That such rapid production of fluid, acid or neutral, may take place in the stomach is best demonstrated by those cases of nervous dyspepsia in which sudden and voluminous regurgitation of fluid occurs in individuals who have taken no fluids for some time previous and whose stomachs are not atonic.

I have given these few examples to demonstrate the possibility for analytical deduction from the results obtained by the determination of the acid gastric secretion. The mere presence of so much acid in a stomach at a given time is not sufficient to establish the digestive capability of the organ, and the older practitioners are justified, to a certain extent, when they look with distrust upon gastric analysis in general. Unless the average capability of the stomach to secrete is developed by a systematic course of examinations in some such manner as given, it would be far better to depend for diagnosis and treatment upon clinical observation and a good history. It is manifestly impossible to demonstrate the secreting power of a stomach by giving one meal or one kind of meal. It would be just as reasonable to expect a dog to secrete natural gastric juice by feeding him flour paste through a tube or by going into the rice fields of Japan to hope to secure an idea of the natural gastric secretion of the peasants by giving them test meals of unsavory and unseasoned plain meat and tea. In the one case proteids are required, in the other carbohydrates. In this country, and in our larger cities especially, people are accustomed to mixed diets, and highly seasoned ones at that; so that the administration of simple food tests will often not suffice to reveal the average natural secretion of the stomach. In order to do this properly more complicated measures are necessary, the rules for which have already been given in the clinical and physiological studies of Bachmann and Pawlaw, by directing us to begin with simple tests, and then gradually to lead up to more complicated ones by adding palatable proteids, etc. By a comparison of the results obtained, we will generally be able to secure a good idea of the average capability of the stomach to digest. At least, we will know how it acts under mild and strong stimulation. Practically this can be accomplished by giving simple tea and bread tests at first and later adding to this same test a simple proteid, such as a quarter of a pound of finely chopped lean beef palatably but simply prepared by broiling and slight seasoning. Two each of these meals should be given upon fasting stomachs upon successive days.

It will sometimes happen, however, that with all possible care as to such systematic examination, we are unable to secure an adequate idea of the secreting capability of some particular stomach in its relation to given symptoms. The reason for this would seem to lie in the very nature of the conditions imposed. Scientific and exact they may be, but they are also more or less unnatural, and in certain individuals of sensitive temperament they may defeat the very object for which they were intended. In a certain proportion of chronic gastric cases, starvation tactics have been employed to such an extent that not only does the stomach not do its work properly, but all the organs are more or less dilatory in their action. In such cases it is advisable at times to feed the patient generously, but plainly, for a few days, and then examine the gastric contents three hours after a plain but appetite-inducing mixed meal. It is remarkable to what extent this simple procedure will often aid in diagnosis by giving results which are quite different from those obtained by previous methods. It may be that the dyspeptic symptoms will be temporarily aggravated by this method, but there is a certain advantage in this also, for the nature of some forms of chronic gastric disease with remittent symptoms can often only be elicited by examination during the period of suffering. At this time any vagaries or abnormalities of secretion are exaggerated to such a degree as to make it possible to detect them easily, whereas the same may be masked in the interval. I can recall several cases of individuals in whom repeated gastric examinations revealed normal secretion, but who would occasionally be taken with very severe pain in the stomach accompanied by excessive gas formation and acid eructation. Examination at this time would show intense hyperchlorhydria with food retention. As the stomachs were perfectly normal in the intervals and the attacks would occur without indiscretions of any kind, in the midst of perfect health, it was difficult to understand the cause for a long time. Close observation, however, revealed that sudden atmospheric changes would bring on the attacks. Whether the primary condition was the hyperchlorhydria, with secondary pyloric spasm and retention or *vice versa*, it would be difficult to say. Judging from the suddenness of onset and the rapidity of development of the attacks, it would appear that a pyloric spasm was the causative factor. In none of these individuals could a general neurosis be demonstrated.

The advantage, for diagnostic purposes, of the existence of pronounced symptoms at the time of examination is further demonstrated in certain other forms of chronic gastric diseases with remittent symptoms. I refer especially to conditions of occasional periodic atony in neurotic individuals. Cases of acute indigestion with retention due to indiscretions are not included in this category. The cases referred to are only those in which a temporary atonic condition is developed as a result of intense mental and physical depression, so commonly encountered in general neuroses. That such a localized muscular weakness in the stomach should accompany the general depression is natural, and the same disappears as the general condition improves. The duration of these temporary atonic conditions may be anywhere from twenty-four hours to days, and they are probably due to temporary loss of excitability in the ganglionic centres controlling the muscular action of the whole alimentary tract. Hence, they are not atonic conditions in the usual sense of the term, for there is no inherent disability in the muscular fibres themselves. Examined during these spells, such a stomach will contain food at a time when it should normally have been empty, and the diagnosis of atony is made, especially if a little sagging is present at the same time. Lavage is ordered, tonics are given, the diet scrupulously regulated, and the patient improves remarkably, whereas a second examination at the end of twenty-four or forty-eight hours would probably have revealed a perfectly normal stomach. Here, again, is demonstrated the necessity for repeated physical examinations in order to determine the average muscular activity of the stomach, for it is quite certain that vagaries may exist in this function also.

It has not been my object in presenting this subject to suggest improvement in the technique of gastric analysis, nor have I intended to convey the impression that the determination of the acid secretion of the stomach is the factor of paramount importance in diagnosis. This one function was selected simply because it was possible by it to judge the value of gastric analysis in general in the light of physiological research. Everyone knows that a proper knowledge of the other function is quite as important, and that all facts, whether they be elicited by chemical analysis, physical examination, or the etiology, must be carefully considered in each case. It is well known further that a correct diagnosis can be made in many instances without any gastric analysis whatever. It seems to me, however, that there is more in gastric analysis than the determination of actual diseased conditions. With these once established, there still remain to be discovered all the individual peculiarities operating in each case. That such should exist lies in the very nature of the complex processes going on along the whole alimentary tract, and is best evidenced in the wide range of the symptomatology, often of a contradictory character, observed in a given number of cases of like pathological basis.

It is in the determination of the average capability of the intact remaining portions of the secretory structures to work that the chief value of gastric analysis lies. Fleiner properly remarks that it does not make much difference which methods we employ for this purpose, provided they are used systematically, and Trousseau long ago suggested that the correct dietetic treatment of a case of dyspepsia would often depend upon the personal experience of the individual patient.

The necessity for some generally accepted system of examination for the proper recognition and classification of chronic gastric diseases is evident from the variety of opinions which exist as to their relative frequency. For some observers the presence of a small quantity of gastric mucus is sufficient to establish a diagnosis of chronic gastric catarrh. Hence, every third case must be looked upon as such. Others regard chronic gastric ulcer as a common condition, whereas in reality all modern methods of examination have very materially reduced its frequency. Gastric dilatation will be a common disease so long as splashing below the umbilicus is deemed sufficient for its diagnosis, and gastroptosis must be very prevalent if we are to take as signs of its existence a contracted thoracic angle or the floating tenth rib of Stiller. No department of clinical medicine lends itself so readily to fads as gastrology, due partly to lack of uniformity of classification, but chiefly to the absence of recognized system in methods of examination employed and the conditions imposed for the same.

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